GEOLOGY OF ARTESIAN WELLS AT ATLANTIC CITY, N. J.

BY LEWIS WOOLMAN.

During the past three years there have been drilled for the Consumers' Water Company at Atlantic City, N. J., four artesian wells. These are of various depths as will be more particularly noticed further on. As the work progressed I have been studying it from a geological stand-point, believing that a careful record of the succession of strata penetrated and of their included fossils would, in connection with information yet to be obtained by developments at other localities, lead to valuable results. Among these would be the construction of a true vertical section across the State from Camden to the sea, showing the amount of dip and the thickness of each of the various Quaternary (?), Miocene, Eocene and Cretaceous beds including also the determination of the number and location of the different water-bearing strata.

Whatever results have been arrived at, their attainment is due primarily to the co-operation of three members of the company, Dr. T. K. Reed, Jos. H. Borton and F. Helmsley, who have afforded every facility for geological investigation. Credit is also due J. H. Moore, contractor for the first three wells and P. H. & J. Conlin, contractors for the fourth well, for much information and for the care they and their assistants have taken to preserve specimens every few feet. These they placed in small dairy salt sacks with Dennison's shipping tags attached, on which they marked the depth and description of material. In scientific circles thanks are due Prof. A. Heilprin for valuable assistance in paleontology and geology, to C. Henry Kain and his co-laborer, E. A. Schultze, for authoritative identification of diatoms, to Dr. D. B. Ward of Poughkeepsie, N. Y., for photo-micrographs of the same which have aided the author in their study, and to C. L. Peticolas of Richmond, Va., for cleaning and separating the diatoms from numerous specimens of earths.

Well No. 1 is situated at the S. E. corner of Michigan and Arctic Avenues; the other wells are grouped within a radius of 100 feet of each other upon a knoll within the meadows about one-fourth of a mile nearly N. W. of No. 1.

Well No. 1 was sunk to a depth approximating 1150 feet. At about 1100 feet a plentiful supply of fresh water flowed to five feet or more above the surface. This water since 1887 has been furnished through street mains to many hotels and cottages.

Well No. 2 was abandoned at 325 feet, on account of an accident.

Well No. 3 was then sunk to 1400 feet, or lower, but without success in obtaining water. Drilling was suspended at this point and the pipe is now being withdrawn in the hope of developing some of the water strata that were undoubtedly passed through probably in a partially closed condition.[1]

These three wells were bored by the process usually used in rock countries by means of the drill and sand pump. The succeeding well, No. 4, was put down by the hydraulic method in which the drill has a hollow body with perforations near the cutting end. To this drill, as the work proceeds, are added section after section of tubing. Down this tubing water is forced by pressure through the perforations above noted and rising between the tube and the casing flows out at the top, continually carrying mixed with it the loosened material from the bottom in finely divided form. This process is much used along the New Jersey coast and is well adapted to soft strata and where no solid rock occurs.

In well No. 4, water flowing above the surface was found at 328, 406, 429 and 554 feet. By pumping, the 328 feet level yielded about 50 gallons a minute, but the 406 feet, only about five gallons.

The water from each of these, although fresh at first, proved salty on being pumped and these strata were therefore cased off. Owing to the toughness of the clay, the pipe—a ten-inch one—could not be driven further than 424 feet; the boring was therefore continued without casing, the walls remaining intact without such support until a total depth of 578 feet was reached. In sand at 429 to 430 feet, a very small flow of fresh water was obtained, but at 554 to 560 feet a gray water-bearing sand was pierced, from which, I am informed, there flowed 50 gallons a minute. By pumping, this yield was at once increased to 150 gallons, and afterwards to 200 gallons. This water has now been pumped several weeks. It proves pure and fresh and is pleasant to the taste.

From well No. 3, there were preserved 184 specimens of earth from as many different depths. These were compared with a carefully kept record of strata furnished by J. H. Moore and the upper

[1] As this article was going to press information was received that a water-bearing stratum was opened at about 720 feet that flowed 10 gallons a minute.

part collated with 37 additional specimens from well No. 4. From this the accompanying section has been constructed, which it is believed is an accurate representation and grouping of strata.

Upon the left is a minute description of the various changes in material copied verbatim from a record furnished by J. H. Moore, with the insertion, however, in brackets of the depths of the various water-bearing horizons, as learned from the development of the other wells. Upon the right the section is subdivided so as to show the grouping of the strata into larger beds having certain characteristic features. For convenience, each of these is marked by a letter, and a corresponding letter heads each paragraph relating to the same in the succeeding detailed description.

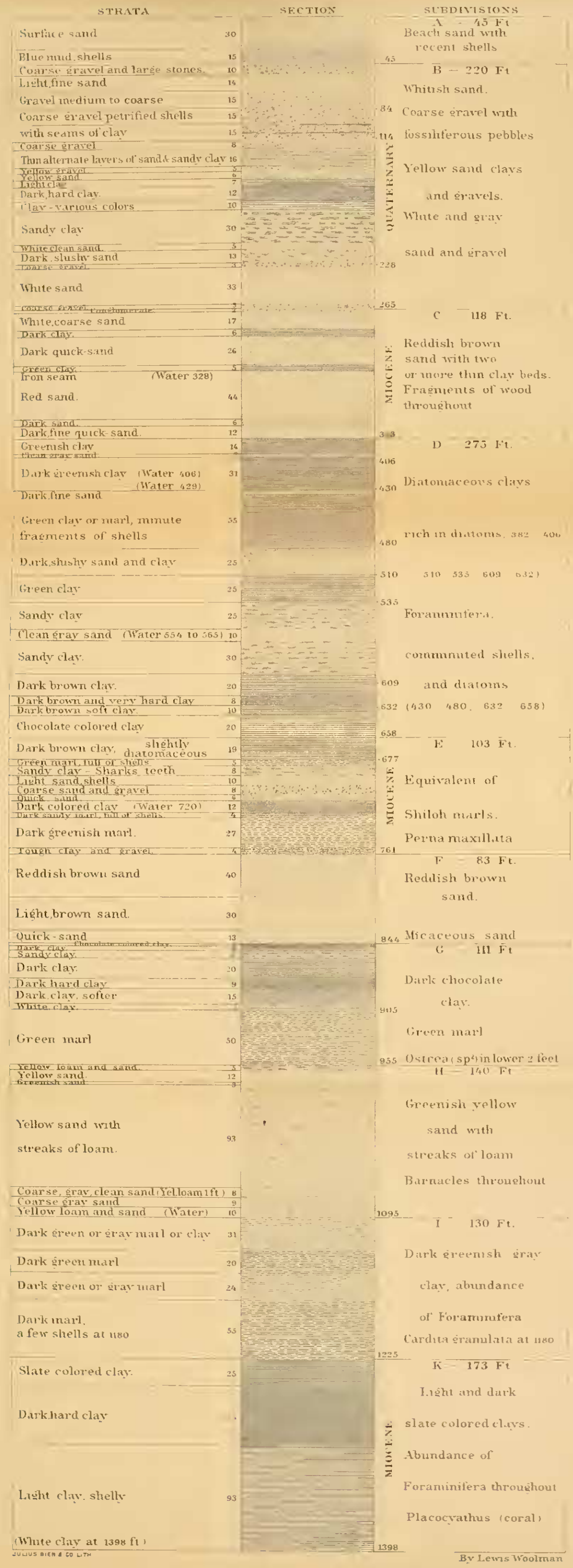
A—Underneath 30 feet of ordinary beach sand there exists 15 feet of blue mud. This was probably the bottom of an old thoroughfare or channel. It contains the usual shells of the coast, the oyster, the clam and the scallop, and also one single minute organism belonging to the foraminifera and identical with the only living species—a *Nonionina*—now found on the beach.

B—Beneath this is a series of sands and gravels 220 feet in thickness, varying from whitish to yellow in color and alternating from very fine sand to very coarse gravel.

At 84 to 116 feet and again at 228 feet, these gravels exhibit pebbles containing fossils that show them to be of Devonian and Silurian origin. Similar fossiliferous pebbles are plentiful at Straffordville north of Tuckerton, and also in the cuts of both the Camden and Atlantic and the Reading Railroads, at about 14 miles from Atlantic City. All of these localities are about 60 feet above tide. Certain yellow gravels and sands at 135 to 160 feet, may be seen apparently matched on a hill N. E. of Ellwood, 120 feet above tide and 21 miles distant. Specimens from the hill and the well are quite undistinguishable. These data indicate a dip of from 12 to not over 15 feet per mile for these gravels. The gravels and underlying white sands of this section are the same respectively as are referred to in the New Jersey survey reports as the yellow gravels and the glass sands. The former have been named by Prof. H. Carvill Lewis, the Glassboro gravels. They are spread over the Atlantic seaboard in this and other States southward and are regarded by many geologists as Quaternary in age. This section terminates in the well at about 265 feet.

COLUMNAR SECTION OF ARTESIAN WELLS AT ATLANTIC CITY NEW JERSEY

Scale of 100 feet to 1 inch



C—The depth last named marks the passage from these nearly horizontal Quaternary strata to the commencement of a long series of Miocene beds with slightly increased dip. The uppermost bed of this series consists of 118 feet of reddish-brown sand ranging from light to dark in color.

It contains a dark clay seam at 289 feet and another at 320 feet described as "green clay;" each of these is about 5 feet thick; from beneath the latter the first flow already noted in well No. 4, was obtained. This red sand bed contains wood throughout that was continually brought up by the hydraulic process in very small fragments, otherwise it is nonfossiliferous.

D—Below these red sands, or from 383 to 658 feet, occurs the most remarkable development of diatomaceous clays yet discovered in the world, being 275[1] feet in vertical extent. Excepting a few pure sand beds, not over from one to ten feet in thickness, this entire horizon is more or less made up of this low order of microscopic plants. As might be expected the diatoms of this deposit are marine forms.

Associated with the diatoms are also a number of sponge spicules, many of them of the pin-head forms that are characteristic of salt water sponges.

At 540 feet were found a few clam and other shells in fragments, but so worn and broken as to be unidentifiable specifically. One, however, was either a *Modiola* or a *Mytilus*.

This deposit is already especially interesting to microscopists, and will become increasingly so until it will attain world-wide publicity. On this account a minute description is here inserted:—

383 to 390, Clay; 390 to 391, Sand, pure white; 391 to 406, Clay.	Rich in diatoms except the sand layer.

406 to 410, Gray sand—No diatoms.
410 to 429, Clay—Moderately rich in diatoms.
429 to 430, Dark sand—No diatoms.
430 to 480, Clay—Diatoms associated with about 5 forms of foraminifera and much comminuted shell.
480 to 510, Sandy clay—Moderately diatomaceous.
510 to 535, Clay—Very rich in diatoms.

[1] Since the preparation of the section, diatoms have been noticed, though very sparingly, in the next lower 20 feet. This would increase the total thickness of the diatom beds to nearly 300 feet.

535 to 554, Sandy clay—Moderately rich in diatoms.
554 to 560, Clear gray sand—No diatoms. Water bearing stratum.
560 to 575, Alternations of pure clays and sandy clays. } More or less diatomaceous.
575 to 600, Sandy clays—Moderately diatomaceous.
600 to 620, Brown clay—Rich in diatoms.
620 to 632, Brown clay—Diatoms in greatest abundance.
632 to 658, Chocolate clay and comminuted shell. Poorly diatomaceous.

The forms from the richest portions at 400, 525 and 625 feet, have been most carefully observed under the microscope and identified by C. Henry Kain and E. A. Schultze.

They have determined 149 species which are distributed among 49 genera. This includes a number of new species, named, described and figured by them in the Bulletin of the Torrey Botanical Club.[1] They are indicated in the following enumeration which includes all so far listed. There will probably, however, be a few forms yet to add. Forms marked rare, are of rare occurrence in the well and not necessarily so elsewhere.

Actinocyclus Ehrenbergii, Ralfs.

Actinocyclus subtilis, (Grev.) Ralfs.

Actinocyclus interpunctatus, Bright. Rare.

Actinocyclus Ralfsii, W. Sm.

Actinodiscus Atlanticus, n. sp., Kain & Schultze.

Actinoptychus areolatus, Ehr.

Actinoptychus Grundleri, A. S.

Actinoptychus splendens, (Ehr.) Grun.

Actinoptychus undulatus, Ehr. var. Halionyx, Grun. Several varieties.

Actinoptychus vulgaris, Schuman, var. Virginica, Grun. Several varieties.

Amphitetras minuta, Grev. Rare.

Anaulus birostratus, Grun. Very rare.

Asterolampra Marylandica, Ehr.

Aulacodiscus Crux, Ehr. Two varieties.

Aulacodiscus Petersii, Ehr.

Aulacodiscus Sollittianus, Norman.

Auliscus Caballi, A. S.

Auliscus cælatus, Bailey.

[1] Vol. xvi, pp. 71 to 76 and pp. 207 to 210; Plates LXXXIX., XCII., and XCIII.

Auliscus pruinosus, Bailey.
Auliscus (Glyphodiscus ?) spinosus, Christian.
Biddulphia aurita, (Lyngb.) Breb.
Biddulphia alternans, Christian.
Biddulphia Baileyi, W. Sm.
Biddulphia Brittoniana, n. sp., Kain & Schultze.
Biddulphia Cookiana, n. sp., Kain & Schultze.
Biddulphia Woolmanii, n. sp., Kain & Schultze.
Biddulphia decipiens, Grun. Rare.
Biddulphia elegantula, Grev.
Biddulphia pulchella, Gray. Rare.
Biddulphia rhombus, (Ehr.) W. Sm.
Biddulphia seticulosa, Grun.
Biddulphia Tuomeyi, Bailey.
Biddulphia turgida, (Ehr.) W. Sm.
Biddulphia longispina, Grun.
Biddulphia Weissflogii, Grun.
Cerataulus (Californicus ? var.) n. sp., Kain & Schultze.
Cocconema lanceolatum, Ehr. Rare.
Coscinodiscus Argus, Ehr.
Coscinodiscus Asteromphalus, Ehr.
Coscinodiscus concavus, Ehr.
Coscinodiscus eccentricus, Ehr.
Coscinodiscus elongatus, Grun.
Coscinodiscus excavatus, Grev. Several varieties.
Coscinodiscus gigas, Ehr.
Coscinodiscus isoporus, Ehr.
Coscinodiscus Lewisianus, Grev. Rare.
Coscinodiscus lineatus, Ehr.
Coscinodiscus Nottinghamensis, Grun. Rare.
Coscinodiscus Oculus Iridis, Ehr.
Coscinodiscus perforatus, Ehr.
Coscinodiscus radiatus, Ehr.
Coscinodiscus rhombicus, Castracane.
Coscinodiscus robustus, Grev.
Coscinodiscus senarius, A. S.
Coscinodiscus symmetricus, Grev.
Cestodiscus ovalis, Grev.
Cestodiscus rhombicus, Grev.
Chætoceros (didymus ? Ehr.)

CRASPEDODISCUS COSCINODISCUS, Ehr.

CRASPEDODISCUS COSCINODISCUS var. NANKOORENSIS, Grun.

CYCLOTELLA OPERCULATA, Kutz.

CYMATOPLEURA SOLEA, W. Sm.

DICLADIA CAPREOLUS, Ehr.

DISCOPLEA PHYSOPLEA, Ehr.

DIMEREGRAMMA NOVA CÆSAREA, n. sp., Kain & Schultze.

DIMEREGRAMMA NOVA CÆSAREA var. OBTUSA, n. var., Kain & Schultze.

DIMEREGRAMMA FULVUM, (Greg) Ralfs.

EPITHEMIA GIBBA, (Ehr.) Kutz. Rare.

ETHMODISCUS ? sp ? Castracane.

EUCAMPIA VIRGINICA, Grun. Rare.

EUNOTIA MONODON, Ehr. Two varieties.

EUNOTIA ROBUSTA, (Ehr.) Ralfs. Several varieties.

EUNOTIA AMERICANA, n. sp., Kain & Schultze.

EUPODISCUS ARGUS, Ehr.

EUPODISCUS RADIATUS, Bailey.

EUPODISCUS ROGERSII, Ehr. Varieties with 3, 4 & 5 processes.

EUPODISCUS sp. ?

GONIOTHECIUM OBTUSUM, Ehr.

GONIOTHECIUM ODONTELLA, Ehr.

GONIOTHECIUM ROGERSII, Ehr.

GRAMMATOPHORA SERPENTINA, Ehr. var. Rare.

HEMIAULUS AFFINIS, Grun.

HEMIAULUS BIPONS, (Ehr.) Grun.

HEMIAULUS POLYCISTINORUM, Ehr.

HUTTONIA REICHARDTII, Grun. var.

HYALODISCUS LÆVIS, Ehr.

HYALODISCUS STELLIGER, Bailey=(PODOSIRA MACULATA, W. Sm.)

LIRADISCUS MINUTUS, Grev.

MASTOGONIA ACTINOPTYCHUS, Ehr.

MELOSIRA SULCATA, (Ehr.) Kutz.

PLAGIOGRAMMA GREGORIANUM, Grev.

PLEUROSIGMA VIRGINIACUM, Peticolas.

PLEUROSIGMA, Sp. ? Fragments of a very large form allied to *P. angulatum.*

PSEUD-AULISCUS RADIATUS, Bailey.

PYXIDICULA CRUCIATA, Ehr.

RHABDONEMA ATLANTICUM, n. sp., Kain & Schultze.

Raphidodiscus Febigerii, T. Christian.
Rhaphoneis gemmifera, Ehr.
Rhaphoneis amphiceros, Ehr.
Rhaphoneis Belgica, Grun.
Rhaphoneis fluminensis, Grun.
Rhaphoneis scalaris, Ehr.
Rhizosolenia Americana, Ehr.
Rhizosolenia styliformis, Bright.
Sceptroneis caduceus, Ehr.
Sceptroneis gemmata, Grun.
Stephanogonia Actinoptychus, Ehr.
Stephanogonia polygona, Ehr.
Stephanopyxis apiculata, Ehr.
Stephanopyxis ferox, (Grev.) Ralfs.
Stephanopyxis Corona, (Ehr.) Grun.
Stephanopyxis Grunowii, Grove & Sturt.
Stephanopyxis limbata, Ehr. Rare.
Stephanopyxis Turris, (Grev.) Ralfs.
Stictodiscus Buryanus, Grev.
Stictodiscus Kittonianus, Grev.
Surirella Febigerii, Lewis.
Tabulina testudo, J. Brun.
Terpsinoe intermedia, Grun. var.
Triceratium Americanum, Ralfs.
Triceratium condecorum, Bright.
Triceratium Ehrenbergii, Grun.
Triceratium Ehrenbergii, (Discoplea undulata, Ehr.)
Triceratium Fisherii, A. S.
Triceratium Heilprinianum, n. sp., Kain & Schultze.
Triceratium Kainii, n. sp., Schultze.
Triceratium indentatum, n. sp., Kain & Schultze.
Triceratium Kainii, Schultze, var. constrictum, Kain & Schultze, n. var.
Triceratium Marylandicum, Bright.
Triceratium obtusum, Ehr.
Triceratium robustum, Grev.
Triceratium semicirculare, Bright. = (Euodia Brightwellii, Ralfs.)
Triceratium spinosum, Bailey.
Triceratium Solenoceros, Ehr. Rare.
Triceratium tessellatum, Grev.
Triceratium undulatum, Ehr.

Tryblionella Hantzschiana, Grun.

Tryblionella scutellum, W. Sm.

Many of the forms are found everywhere from top to base of this section. Among these *Melosira sulcata* is one of the most frequent. Others are found predominating only at certain horizons; among these may be noticed a beautiful iridescent, many-rayed disc form, *Actinocyclus Ehrenbergii* which is characteristically abundant at 625 feet; it occurs sparingly at 525 feet but is scarcely if at all seen at 400 feet.

At about 525 feet the genus *Rhaphoneis*, an elongated form, occurs more frequently than elsewhere and in many varieties. Associated with it at this same depth are a number of rare forms heretofore found only in this country in an Artesian well at Cambridge, Md., at a depth of 275 feet, and again in a well at Fortress Monroe at a depth of 558 feet. The general resemblance seen in strewn mounts from Cambridge and Atlantic City is so great as to suggest an exact identity of strata. More light, however, will be needed to definitely settle this point.

Respecting *Rhaphoneis*, the variety of forms grading almost insensibly from one to the other is so great that it is possible to so arrange a dozen or more side by side in a line that differences are not readily appreciable except by skipping over intermediate forms and comparing those some distance apart. In fact, T. Christian has shown me a slide containing 16 such forms from the Cambridge well, and C. Henry Kain has remarked respecting these same forms at Atlantic City, that they "present such variations of structure as to suggest the advisability of decreasing the number of species usually considered as belonging to this genus."

There is a curious anomaly in connection with a newly described elongated species, *Biddulphia Brittoniana*, found at 525 feet. In this the two frustules composing one individual and usually presenting their convex sides outward, have never been observed in that manner, but instead, two frustules separated from different individuals are found with their convex sides inward and fastened together by the interlocking of curiously hooked setæ at both ends of each frustule.

At 425 feet five foraminiferal forms are associated with the diatoms. After chemical treatment of earth from this depth for the cleaning and separation of the diatoms one species of foraminifera, a *Textularia* remained intact in the form of a siliceous internal cast—the shell having been destroyed by the acids used.

In the sands interbedded between these diatomaceous clays occur the three lower of the water-producing strata noticed in connection with well No. 4. The upper one as before stated proved unsatisfactory; the middle gave but a scanty flow, and the lower yielded an abundant supply of water.

In a letter received by the writer from the late Prof. George H. Cook he says: " I have written the well contractors and also marked on a geological map the location and dip of strata and the depth and location of the wells on the water-bearing stratum from which Atlantic City may reasonably hope to get a supply of good water and have assured them that it should be carefully looked for at 530 to 600 feet below sea level," and in a letter to a member of the company he named 577 feet as the probable depth. This came very close to the fact as was afterwards realized.

In the letter to the writer just quoted he states "that the bored wells at Barnegat, Harvey Cedars, Weymouth, May's Landing and Pleasant Mills have all the same quality of water, have passed through similar strata, and are on a dip of 25 feet per mile."

Assuming as probable that the wells at Pleasant Mills and well No. 4 at Atlantic City draw from the same stratum, and measuring the distance between the two locations at right angles to lines drawn through each parallel to the trend of the cretaceous strata we have 22 miles. The well at Pleasant Mills is of 34 feet depth below tide. This would make the dip for at least the upper portion of the Miocene beds 23 to 24 feet per mile, thus harmonizing with the views of the late State Geologist.

E—Beneath the diatomaceous clays and occupying the next 103 feet, or from 658 to 761 feet, occurs a series of fossiliferous beds as follows:

Chocolate clay, comminuted shell, slightly diatomaceous. See footnote page 135.			19
677 to 700.	Fossil	5 ft. Green marl full of shell 8 ft. Sandy clay full of shell 10 ft. Light sand full of shell	23
		8 ft. Coarse gravel & sand nonfossiliferous 6 ft. Quicksand nonfossiliferous 12 ft. Dark chocolate clay nonfossiliferous	26
726 to 757.	Fossil	4 ft. Sandy marl and shell 27 ft. Green marl with shell	31
		Tough clay mixed with gravel	4

These beds are probably the same as the Miocene shell outcrops at Shiloh and Jericho near Bridgeton, N. J. The lower of the two fossil horizons within this section showing some of the rarer forms found at these localities. The species found here will be again referred to in connection with those from greater depth.

F—The next interval of 83 feet is occupied by sands, the upper 73 feet being reddish-brown in color and much like those above the diatom beds and the lower 13 feet being a gray micaceous quicksand.

G—Between 844 to 955 feet are included a clay and a marl bed as follows:

844 to 905.	Fossil	Dark chocolate clay; a few fossils at 875 feet.	61
905 to 955.	Fossil	Green marl; lower 2 feet a bed of ponderous oysters so broken by the drill as to be undeterminable as to species.	55

H—The next section from 955 to 1095 feet covers 140 feet of peculiar greenish-yellow sands with many streaks of loam of the same color. It contains barnacles throughout, indicating a shallow sea. This was further corroborated by a few shallow water mollusks at about 1000 feet.

I—From 1095 to 1225 a series of 130 feet includes two marl beds and is best described thus:

1095 to 1126,	Dark greenish-gray clay; abundance of foraminifera.	31
1126 to 1146,	Dark green marl.	20
1146 to 1170,	Dark green marly clays.	24
1170 to 1225,	Fossil, Very dark green marl; *Cardita granulata* at 1180 feet.	55

From this point downward, as far as the boring continued, to 1,400 feet or thereabout, is one continuous bed of tough clay, light to dark slate in color and containing multitudes of foraminifera especially in the lighter colored clays.

There are also from this bed a few mollusks and quite a number of specimens of deep sea corals belonging to the genus *Placocyathus* very similar to an undescribed form from the Miocene deposits of San Domingo and now in the Academy's collection.

The life forms of this division indicate a deepening sea. The foraminifera very closely resemble species described in 1846, by d'Orbigny from the Miocene clays around Vienna.

Forms representing at least 14 genera occur in all the clays below 1,095 feet while about five of the same generic forms have been observed between 430 to 480 feet. The genera are as follows :—

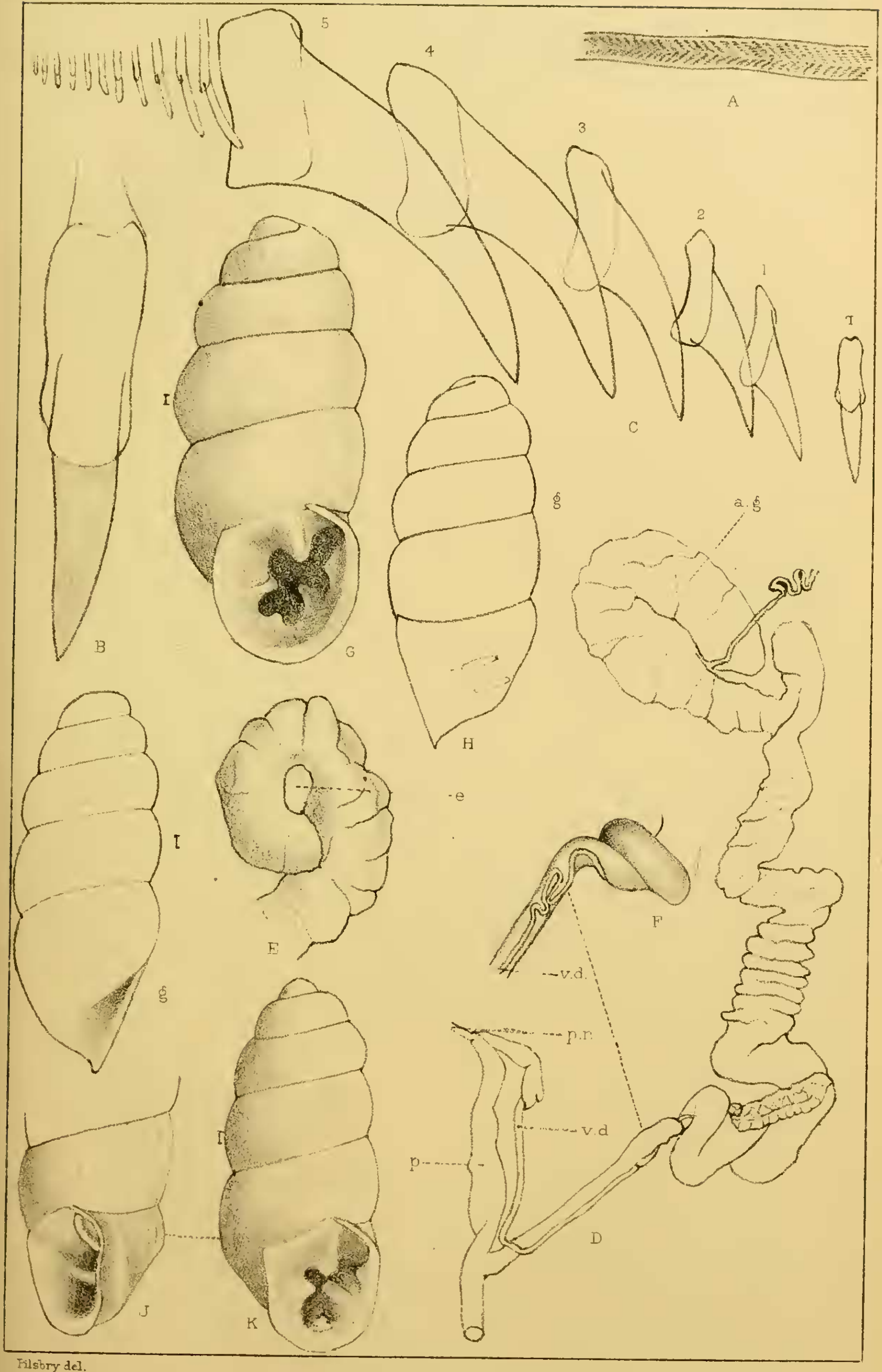
Nodosaria, Dentalina, Cristellaria, Robulina, Nonionina, Rotalina, Rosalina, Bulemina, Uvigerina, Amphistigina, Guttulina, Biloculina, Triloculina and Textularia.

It now remains to enumerate the fossils, excepting the microscopic ones already listed. Although generally in very fragmentary condition, it has been possible to name 82 species of mollusks, exclusive of 8 forms determinable by genera only. Besides the mollusks there were representatives of eleven other life forms, among them a few varieties of corals and a bone belonging to an animal of the crocodilian order. Identifications of all the fossils, excepting the microscopic, have been very kindly made by Prof. A. Heilprin. Specimens obtained from both wells No. 1 and No. 3 are included. In those from No. 3 the depth where each was found is given ; in No. 1 this is not known. Of the 41 molluscan forms from well No. 1 and noted in the Academy's Proceedings for 1889, all but 12 were again found in well No. 3.

The list is as follows :

ANOMIA probably EPHIPPIUM.
ARCA CENTENARIA.
ARCA SUBROSTRATA, 682.
ARCA (IDONEA ?)
ARCA LIENOSA, 725.
ARCA PLICATURA.
ARTEMIS ACETABULUM.
ASTARTE OBRUTA, 682.
ASTARTE PERPLANA, 700.
ASTARTE THOMASII, 875.
ASTARTE CUNEIFORMIS, 695.
ASTARTE COMPSONEMA, 725, 875.
AMPHIDESMA SUBREFLEXA, 750.
CARDITA GRANULATA, 682, 750, 885, 1180.
CARDITA ARATA.
CARDIUM CRETICULOIDES or LEPTOPLEURA, } 700.
CARDIUM LAQUEATUM, 700.
CORBULA CUNEATA, 750.
CORBULA IDONEA, 700.

Corbula elevata, 752.
Corbula sp.? 900.
Chama congregata, 700, 750.
Crassatella melina.
Cytherea sp.?
Donax variabilis.
Gouldia lunulata or Astarte, 1350.
Lucina trisulcata, 752.
Lucina crenulata, 752, 875, 1350.
Lucina Foremani, 695–730.
Mactra lateralis, 682, 752.
Mytiloconcha incurva.
Mytilus incrassatus, 682, 752.
Mysia acclinis, 752.
Nucula obliqua=proxima, 730.
Neæra sp., 1335.
Ostrea Mauricensis, 682.
Ostrea sp., { 182, 725. 955, 1000. }
Pecten Madisonius, 682, 750.
Pecten Humphreysii, 677, 700.
Pecten vicenarius.
Pecten Marylandica, 726, 1000.
Pecten comparilis.
Pectunculus parilis, 726.
Pectunculus lentiformis, 752.
Perna maxillata, 682, 750.
Saxicava arctica, 740.
Tellina subreflexa.
Tellina declivis, 752.
Yoldia or Leda, 752.
Volvula or Bulla, 1380.
Venus altilaminata 682, 730.
Venus sp.? 687, 750.
Discina lugubris.
Cerithium sp.? 875.
Columbella (Amycla) communis, 740.
Cylichna sp.?
Crepidula sp.? 690, 750.
Dentalium sp.? 690.



Pilsbry del.

PILSBRY ON AEROPE AND PUPA.